



MANUFACTURE OF ACETANILIDE

NCL Process Goes into Commercial Production

Acetanilide is an important organic intermediate which is extensively used in the pharmaceutical industry for the manufacture of sulpha drugs. It is also used in large quantities in the dyestuff industry for the manufacture of valuable dyestuff intermediates. The annual demand of the chemical for the manufacture of sulpha drugs alone is estimated at 2000 tonnes valued at Rs 1 crore. A saving of Rs 75 lakhs per year in foreign exchange can be effected when it is produced indigenously.

As a measure of import substitution, work on the development of a process for the production of acetanilide was undertaken by the National Chemical Laboratory (NCL), Poona. After optimizing the conditions on a laboratory scale, the laboratory designed and set up a 60 kg batch pilot plant, which by suitable alterations could be used for batch sizes up to 100 kg. The necessary chemical engineering data were collected in the plant, and based on the data, complete process design of a plant for manufacturing 2000 tonnes of acetanilide per annum was prepared. The scale-up factor was 40 and the reactor design was for 4 tonnes of acetanilide per batch. The process in its final form gave a consistent yield of over 98% acetanilide based on aniline. The product conformed to the stringent specifications of the Indian Standards Institution and also of many leading manufacturing houses.

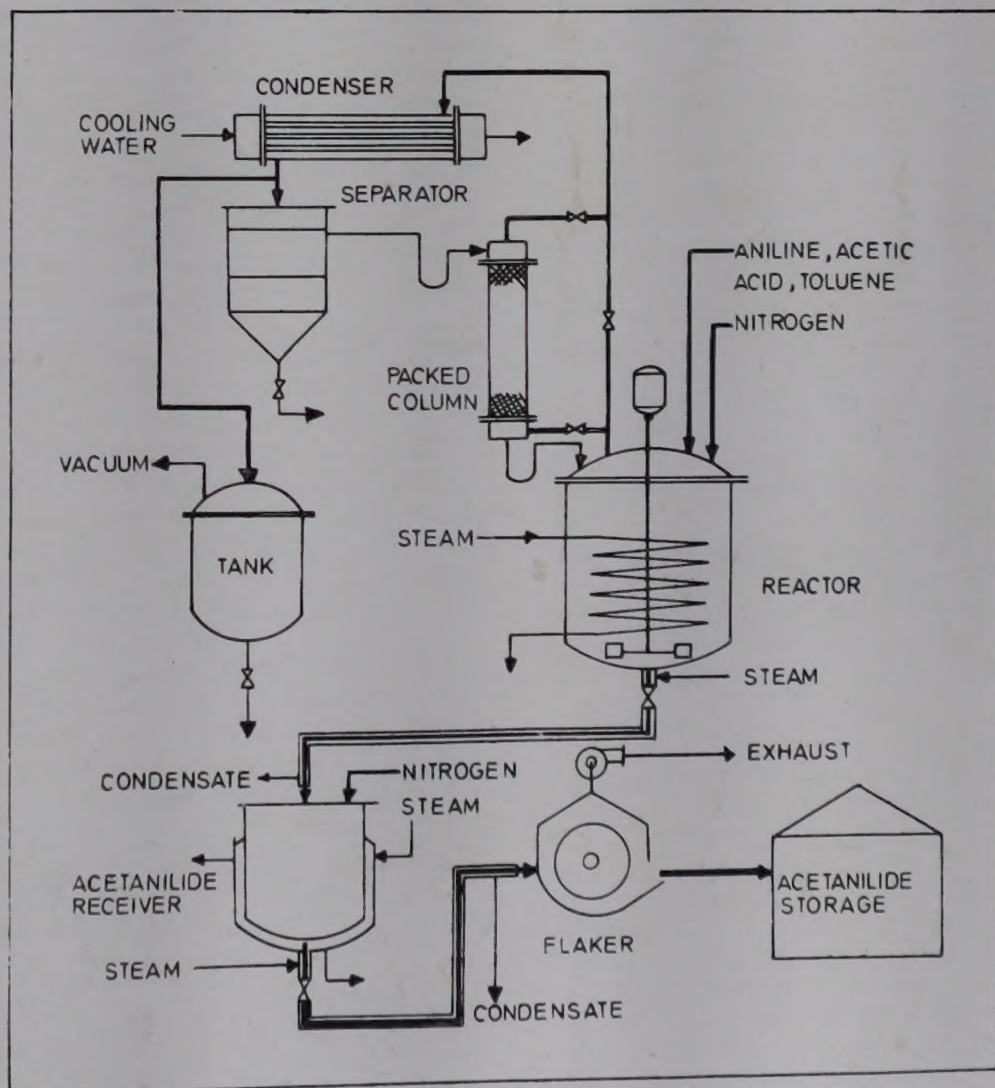
The process consists in reacting aniline with a slight excess of acetic acid in liquid phase under atmospheric pressure in a stainless steel reactor fitted with a stirrer and heat-

ed by means of steam. Toluene is used as an entrainer for removing the water of reaction as azeotrope. The vapours pass through a packed column and continuously condense in the condenser. The liquids are allowed to separate in a separator. The bottom aqueous layer consisting

of water and acetic acid (concentration, 16-18%) is continuously drained out. The top layer of toluene is continuously fed back to the top of the packed column.

At the end of the reaction, unreacted aniline, excess of acetic acid and toluene, present in the reactor along with acetanilide, are removed by vacuum distillation. These are then mixed with the main stream of the next batch and the reaction is carried out as before.

The molten acetanilide (mp, 113°C) is transported from the



Flowsheet for the manufacture of acetanilide by the NCL process

reactor under nitrogen pressure, and through steam-heated jacketed pipeline to the acetanilide receiver. The jacket of the acetanilide receiver is heated by steam to keep the product in molten condition. The molten product is then transferred under nitrogen pressure into a water-cooled flaking unit where it is continuously removed as acetanilide flakes. It is then weighed and packed in polythene lined gunny bags and sent to storage.

The laboratory offered this process through R. L. Dalal and Co. (a firm of project engineers in Bombay) to the Hindustan Organic Chemicals Ltd (HOC), Rasayani, who

invited tenders for a plant of 2000 tonnes/annum capacity. The tenders submitted by the firm, based on NCL know-how and process design, was adjudged the best among the global tenders received.

Trial runs on the acetanilide plant at Rasayani started in February 1969, and since January 1970 the plant has been running to full capacity and with better efficiency than predicted by NCL.

The laboratory also assisted HOC in the setting up of the plant at Rasayani and carried out in-plant trials after the plant was set up.

cultures of yeast or bacteria. Gas oil, the fraction obtained during the distillation of crude oil, was the substrate while a number of organisms isolated from yeast were used for obtaining single cell proteins. The results showed that RAY-13, identified as *Trichosporon pullulans*, grows fast on gas oil resulting in a single cell protein whose contents of proteins and four essential amino acids, specially important to Indian diet, are better than other single cell proteins obtained using various other cultures. Another paper presented on this subject was from the Indian Institute of Petroleum, Dehra Dun. The paper discusses the importance of factors like agitation, aeration and nature of feedstock on the culture of microorganisms utilizing hydrocarbons as carbon source.

The present-day antibiotic production in the country necessitates the import of certain raw materials like soyabean meal and oil; the former is the source of protein and the fat is useful as a defoaming agent. The research teams from the National Botanic Gardens, Lucknow and the Central Drug Research Institute, Lucknow report that the refined fat from *Jatropha curcas* (which grows wild in the Deccan peninsula) could be used as a defoaming agent in microbial fermentation industry.

A large number of the papers from universities and other laboratories dealt with the production of riboflavin and vitamin B₁₂ using whey; formation of elemental sulphur from gypsum using *Thiobacillus* spp., production of diacetyl using *Saccharomyces cerevisiae*; terpene fermentation by bacteria; preparation of lactic acid from cane molasses; production of itaconic acid using *A. terreus*; and production of glutamic acid using *Pseudomonas aeruginosa*.

Recommendations

The following recommendations were made at the conclusion of the symposium.

1. In every research work involving industrial fermentation there are there major steps involved: (i) screening of microorganisms for

Industrial Fermentations : Symposium at RRL, Jammu

A symposium on 'Industrial fermentations with special reference to indigenous raw materials and needs of the country' was held at the Regional Research Laboratory (RRL), Jammu during 13-18 March 1970. The main objectives of the symposium were to take stock of the present position of industrial fermentation in the country, and to gather and process the data made available by various microbiological laboratories so that the information could be utilized in increasing the scope for industrial fermentation using indigenous raw materials.

Thirty-two papers covering various aspects of industrial microbiology were presented and discussed. The possibility of utilizing new isolates/strains of microorganisms in industrial fermentations was the theme of most of the papers.

One of the papers from RRL, Jammu dealt with the production of citric acid by submerged fermentation, an important project under investigation at the laboratory. Citric acid is required by the food, beverage and pharmaceuticals industries and is imported to the tune of 1500 tonnes/annum, valued at about Rs 60 lakhs. Of the various carbohydrate raw materials used, cane-sugar was found to be the best

substrate for conversion to citric acid, the yields being 90-95% in shake flasks and 70-75% in the laboratory fermenters. Sugarcane juice, which has not been tried so far for citric acid manufacture, gave encouraging results (60-70% conversion on the basis of starting sugar). The laboratory has also developed a strain of *Aspergillus niger* which is highly amenable to industrial exploitation. Two review papers dealt with microbiological production of citric acid.

Use of mushrooms for converting vegetable wastes into edible products has been extensively suggested as a means of solving the problem of food scarcity. Of the large number of species of mushrooms tried on a wide variety of culture media for producing mushroom mycelium in submerged culture, *Morchella* sp. were found to be the best, especially an isolate of *Morchella* obtained from Kashmir valley, as it contains 26.25% protein and all the essential amino acids. The paper was contributed by T. N. Kaul and A. Hussain of RRL, Jammu.

Extensive work has been carried out by RRL, Jorhat on the production of single cell proteins from petroleum hydrocarbons using

potency/efficiency of producing the required chemical or bringing out the desired biochemical processes, in shake flasks; (ii) studies in 10-100 litre fermenters to examine the possibilities of producing the same chemicals in desired quantities with indigenous raw material, the variables involved and the economics of the process; and (iii) trials in 500-litre or bigger fermenters to scale up the process and to work out the necessary details for designing the commercial unit, work out the optimum conditions for commercial operations and economics of the process.

The first step involving the screening of strains and various laboratory studies is being carried out by many laboratories in India. There is ample scope for expanding this work to other centres and strengthening the work already on hand. This requires adequate financial assistance from all the agencies concerned such as the Planning Commission, the Indian Council of Agricultural Research and CSIR.

The second step involves special efforts through coordinated approach involving microbiologists, chemists, biochemists, chemical engineers and technologists. Such work can be carried out at a few centres and the facilities and staff required are to be provided at these centres. The results of research at university centres, research laboratories, etc. should be test-verified in the pilot plants. There is need for setting up a coordinating body and to work out the procedure for this work. The finances required may be provided by the Planning Commission.

The third step involves the testing of the process for industrial viability and can be carried out only in two or three centres. The public sector undertakings at Pimpri and Rishikesh, as well as the facilities available in the private sector, should play an increasingly effective role in this important phase of the work. The authorities concerned may evolve a procedure for the purpose.

2. Considering the great awakening in the public mind on the needs of balanced protein diet, adequate quantities of certain essen-

tial and industrially important amino acids should be produced through industrial fermentation in the country. Lysine, threonine, tryptophan and glutamic acid could be produced through microbial processes. Extensive research work is required to evolve potent strains of microorganisms.

3. In the case of citric acid production, the work at RRL, Jammu has shown definite promise; this needs to be intensified so that the long standing problem of the industry is effectively solved. There is, however, need for continued effort on the part of other interested microbiologists such as the group at Hissar; Bose Institute, Calcutta; and others to evolve new strains and to improve the process for the manufacture of citric acid from molasses available in the country.

4. Industrial fermentations to produce microbial enzymes have not made the desired progress in spite of extensive work carried out in recent years in India. It is therefore necessary that the Government of India should take adequate measures to encourage Indian know-how in expanding the production of enzymes, such as amylases, proteases, pectinases and cellulases. Before issuing licences for the manufacture of enzymes in India with foreign collaboration, the available technical know-how in India should be carefully looked into, and wherever possible, Indian know-how should be given preference to the maximum extent.

5. There is adequate information available in India on the usefulness of legume inoculations with *Rhizobium* cultures in increasing crop production and in improving nitrogen economy of the country. Industrial production of certain strains of *Rhizobium* for legume seed inoculations should be taken up on top priority basis. Work on other bacterial fertilizers such as *Azotobacter*, *Beijerinckia*, *Phosphobacterium*, *Anabaena* and *Nostoc* needs to be intensified with the object of examining the possibilities of mass production of each of them for use in farmlands.

6. The need for microbial insecticides for integrated control of insect pests of crop plants is

increasingly felt. Work done in India and abroad has shown the high potency of *Bacillus thuringiensis* in this regard. The available strains of this organism should be taken up for production at pilot plant level. Work on other bacterial insecticides should be intensified to screen efficient organisms for industrial production.

7. The present efforts to produce single cell proteins through yeasts and bacteria, utilizing hydrocarbons and agricultural and industrial wastes, need to be strengthened with a view to utilizing the knowledge for large scale production of single cell proteins for animal feed and later on as human food supplements.

8. At present only two laboratories are carrying out research work on enology, utilizing the available agricultural raw materials. This work needs to be expanded and intensified so as to support production of better quality wines and other alcoholic beverages within the country. This will lead to the saving and earning of foreign exchange.

9. The work on lactic acid fermentation, ergot alkaloids, steroids, mushrooms, sulphur bacteria and other conversions of farm and industrial wastes into useful substances, presently carried out by some of the microbiological laboratories in the country, needs to be intensified through additional facilities and staff.

10. The work on continuous fermentation is still in an experimental stage in most of the advanced countries. In India adequate support should be given to this work so that the technological details for continuous fermentation in some of the present fermentation processes could be worked out.

The participants stressed the need for holding similar meetings every year to review the progress of work on industrial fermentations and for inviting representatives from industrial organizations and technologists and biochemists. Emphasis was also placed on the participation in greater measure of the concerned industry and the technologists. The Planning Commission may provide financial support to hold such meetings.

Corrosion in Fertilizer and Petroleum Industry

The proceedings of the short course on 'Corrosion in fertilizer and petroleum industry', organized by the Corrosion Advisory Bureau of the Metals Research Committee of CSIR at Udyogamandal from 20 to 24 Dec. 1968 (*CSIR News*, Vol. 18, p. 98), have been compiled and published by the Bureau. The volume contains nine papers concerning the various aspects of corrosion problems in the two industries.

Petroleum and fertilizer industries are the two key industries which are making rapid progress in India. These industries encounter serious corrosion problems in every phase of operation, requiring constant attention. Starting with the atmospheric corrosion of steel structures in the oilfields and the conveyance of crudes through underground pipelines, the problem of corrosion becomes increasingly severe in the refineries and fertilizer plants. The problems of keeping the process equipment, handling highly corrosive fluids in different sections of the refinery plant and transportation of the crudes and refined products, are of great importance. Bringing down the losses due to corrosion, the main concern of the petroleum and fertilizer industries, is the theme of most of the papers read and discussed at the course. The course focussed the attention on the gaps existing between plant engineers and corrosion scientists with regard to the causes and prevention of corrosion as well as the lag between theory and practice.

'Chemical corrosion and its prevention' is the title of an article by N. Subramanyan of the Central Electrochemical Research Institute (CECRI), Karaikudi. The article, which deals with the mechanism of corrosion and its prevention, discusses the electrochemical method of corrosion prevention—the anodic protection—developed by CECRI. In this method, the structure to be protected is made the anode with respect to another cathode dipped into the solution. The method is based on the principle that steel, stainless steel, titanium, etc. can form a protective, passive oxide layer when their potential is raised to a suitable value in the anodic direction and

maintained at that level by a constant flow of current. The advantage of the method is that current consumption is low. However, the method is applicable only to some metals which can be anodically passivated; requires a special electrical device to maintain the potential of the protected structure at the desired level; and in the case of current failure, the protective action is lost.

Many equipment in fertilizer and petroleum industries suffer premature failure by intergranular attack and stress corrosion cracking. Intergranular attack is the result of changes in the metallurgical structure near the welded zones in stainless steel. The combined action of stress and corrosion gives rise to stress corrosion cracking of copper alloys, mild steel and stainless steel. The conditions which lead to these types of failure and the methods of counteracting them are discussed by A. K. Lahiri of the National Metallurgical Laboratory (NML), Jamshedpur.

The corrosion problems encountered in the manufacture of nitrogen based fertilizer salts, phosphoric acid and superphosphate are reviewed by A. K. Roy and K. M. Verma of the Fertilizer Corporation of India Ltd, Sindri. The article presents a number of case histories and the measures taken in several parts of the world.

An article by A. K. Lahiri and H. R. Thilakan (NML, Jamshedpur) outlines the causes of corrosion in the production and refining of petroleum crudes as also measures to prevent corrosion. Another article dealing with corrosion and erosion problems in petroleum refineries is by G. Rama Rao of the Indian Oil Corporation Ltd, Barauni, in which practical cases of corrosion failure in the Barauni refinery are dealt with.

The corrosion problems relating to the storage and transport of petroleum products and bulk handling of fertilizers are discussed by R. K. Banerjee and C. P. De of the Naval Chemical and Metallurgical Laboratory, Bombay.

Papers read and discussed at the final session on 'Corrosion prevention methods', include : (i) Corrosion in circulating water systems and

its control (K. S. Rajagopalan, CECRI, Karaikudi); (ii) Cathodic protection of metals; and (iii) Corrosion of structural materials (both by K. P. Mukherjee, NML, Jamshedpur).

The volume (159 pages) is useful both to the corrosion scientists and plant engineers who are concerned with corrosion problems encountered in petroleum and fertilizer industries.

High Strength Concrete Mix Design : A Case Study

Though considerable work has been done on the design of concretes of low strength ($<200 \text{ kg/cm}^2$) and medium strength ($200\text{--}400 \text{ kg/cm}^2$) comparatively less attention has been paid to the design of high strength ($>400 \text{ kg/cm}^2$) concrete mixes. This may be due to the infrequent use of high strength concretes as well as to the numerous factors such as water-cement ratio, richness of mix, nature of aggregate, angularity, grading, maximum size, proportions of fine aggregate, etc. which affect the high strength concrete mixes. The results of a study made by the Cement Research Institute of India (CRI), New Delhi, on the effect of variability in aggregate grading on the strength and workability of high strength concrete mixes ($400\text{--}650 \text{ kg/cm}^2$), designed to the average grading, are presented in a mimeographed report issued by the institute.

The results point to the conclusion that the workability of the higher strength concrete mixes could be increased to some extent by using greater proportion of cement, but such mixes might prove uneconomical. Use of intense vibration accompanied by pressure on the surface of concrete is needed to compact satisfactorily the stiff mixes and this may prove more economical and satisfactory than richer mixes.

Variations in aggregate grading are detrimental to the strength of concrete made from proportions designed for the average grading. To obtain concrete of uniform quality and to minimize the chances of getting lower strengths, the variations in the aggregate grading should be avoided. Designing of concrete mixes to include the variability resulting from non-graded aggregates

is uneconomical, specially in the case of high strength concretes, and use of suitable screening for separating the different sizes and remixing as per the designed grading might prove more economical in the long run.

Efficiency of Grinding in the Manufacture of Cement

A Review

Grinding of raw materials and grinding of clinker are two important operations in the manufacture of cement. The efficiencies achieved in terms of energy utilization are of the order of 0.1 to 1.0% only. It is necessary to improve the efficiency of grinding in order to lower its cost. As a first step in this direction, the Cement Research Institute of India (CRI), New Delhi has published a review report (RR-3-70) covering the fundamentals of grinding operation together with an analysis of the existing theories of comminution. The report also contains information on the areas in which further work has to be carried out for a better understanding of the principles and mechanism of comminution with a view to finding optimum solutions to technological and operational problems.

A comprehensive approach in formulating a comminution theory would be in giving a rate equation to describe a continuous milling system, but the selection and distribution functions will have to be based on probability considerations. The development of generalized analysis for all materials regarding selection and distribution function seems improbable because the degree of heterogeneity influences the probability of breakage, which in turn, governs the strength.

In a comminution process, the energy required to bring about fracture is not a constant physical property of the material. The energy is influenced by the rate of application of stress, mode of application and the grindability of the material. Not much work has been done in giving a theoretical analysis of the energy utilization and the energy balance in any typical mill.

It is further suggested that the utility of this review for the purpose of the development of a comprehensive theory and analysis of grinding

process can be further enhanced by covering the following aspects: (i) comparison of experimental investigations by various investigators, (ii) work regarding the application of mechanistic approach to various mills and milling circuits, and (iii) a

comparison of the grinding efficiencies with and without the adoption of grinding aids.

A bibliography containing 308 references arranged in chronological order is included in the report.

PROGRESS REPORTS

CPHERI Annual Report 1966-67 & 1967-68

Eighty-seven research projects were in progress at the Central Public Health Engineering Research Institute (CPHERI), Nagpur in the fields of water quality (30), sewage characterization (25), industrial waste treatment (24), industrial hygiene and air pollution (5), and rural sanitation (3) during 1966-67 and 1967-68 according to its report for these two years published. The progress made under each project is indicated in the 153-page report (mimeographed).

At the instance of the Indian Standards Institution (ISI) the institute carried out investigations to find out whether bacteria can multiply in waters flowing through plastic pipes. The investigations showed that polythene and polyvinyl chloride pipes are safe for conveyance of drinking water. On the basis of the institute's findings ISI formulated specifications for low density polythene pipes for cold water services.

The institute designed for the Army a vertical pressure filter made of aluminium shell using specially graded sand media for purifying water for drinking. The filter does away with the use of diatomaceous earth (imported) and is designed to withstand a pressure 25 psi, and the filtered water is delivered at atmospheric pressure. It has a capacity to treat 1000 gal/hr with turbidity up to 100 units.

The comparative efficiencies of iodine and chlorine for destruction of bacteria and helminths were studied. To disinfect small community water supplies, a concentration of 4.0 mg/litre of chlorine was found satisfactory after 30 min contact period at pH 9 and 10°C. Under the same conditions the concentration of

iodine required was 8.0 mg/litre. The disinfecting activity of chlorine was found to be affected by change in pH while that of iodine was unaffected. For disinfection of field waters, whose pH varies considerably from place to place, iodine is preferred.

A new series of coagulant aids, designated CA-series, for removing suspended matter from water, sewage and industrial wastes was developed. Laboratory studies showed that the CA-series coagulant aids as comparable to Separam AP-10 in reducing alum dose: 5-10 mg/litre of CA-series coagulant aids bring about 50% reduction in alum requirement.

Seven pilot plant investigations were under way. One of them was concerned with the study of the efficiency and economics of Imhoff tanks for the treatment of sewage for small communities. Two night-soil digesters of capacity 210 litres each were constructed at Bazonbagh (Nagpur) to study the optimum conditions of anaerobic digestion of night-soil with special reference to loading, detention period, dewaterability and manurial properties of the digested sludge, decay of bacterial and helminthic parasites and effect of hydraulic recirculation and gas recirculation on the digestion process. Another is on the high rate sludge digester at Hyderabad, a study undertaken in collaboration with the Hyderabad Municipal Corporation to obtain data for the proposed remodelling of the existing sewage treatment plant at Amberpet. The plant is designed to treat 1 lakh gal of sewage per day. At the oxidation pond at Bhandewadi the method of treatment of domestic sewage by means of oxidation pond was being studied in detail.

To study the suitability, efficiency and economics of AKX Bi-Flow filter as compared to that of conventional rapid gravity filters, a pilot plant of 0.5 million gal/day capacity is being installed. The pilot mechanical composting plant of 600 kg/day capacity, based on modified Bangkok process, was designed. To find out the optimum conditions like detention time, power requirement in relation to BOD removal, maximum loading in terms of BOD applied, speed of the rotor and the depth of immersion of the blades on the performance of the brush for treating domestic sewage and industrial wastes, an oxidation ditch holding 20 000 gal was constructed

in the institute's premises on the lines proposed by Pasveer and Baars and based on the findings made in the laboratory experiments.

The institute rendered technical assistance and consultancy services to 101 agencies in the public and private sectors in the field of public health engineering during this period. This was done through the institute and its four zonal centres and five field centres.

A symposium on 'Community water supply and waste disposal' was organized by the institute in Nagpur in 1966, and the proceedings were published. Seventy-five research papers were published.

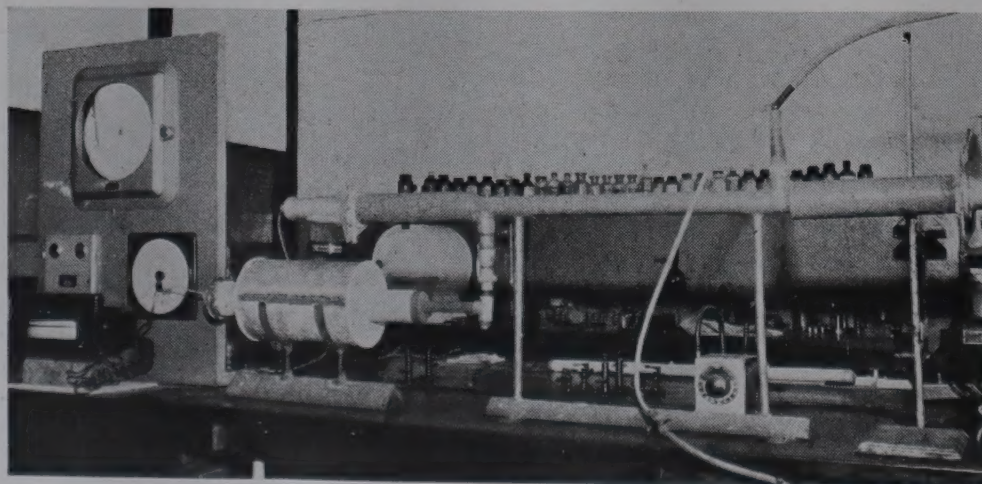
CFRI Smoke Density Indicator

There is no standard and reliable method to measure smoke emission from domestic fuel, and consequently difficulties are encountered in declaring a fuel smokeless.

An apparatus has been designed and fabricated by the Central Fuel Research Institute (CFRI), Dhanbad to specify the smokiness of domestic fuels in terms of smoke index. The method employed consists in burning a few grams of coal in a furnace, letting out the smoke into a horizontal pipe through which a beam of light travels. At one end of the pipe is placed a source of light and at the other a photoelectric cell. Thus the smoke pipe serves as an absorption tube. Depending on the density of the smoke, the intensity of the light

beam varies and in turn falls on the light-sensitive surfaces of the photoelectric cell. This variation is indicated on a galvanometer scale calibrated from zero to 100. The zero reading corresponds to full light intensity (i.e. no smoke) and the 100 reading to zero light intensity. By directly taking the reading on the scale at various time intervals the smokiness of a fuel can be calculated in terms of 'smoke index'. Fuels having an index below 400 can be regarded as smokeless for use as domestic fuel.

The results of the burning performance of different fuels have shown that smoke index decreases as the rank of the coal increases or as the volatile matter decreases.



Smoke density indicator designed and fabricated by CFRI, Dhanbad to gauge the smokiness of domestic fuels in terms of smoke index

Bricks from Kallar Soil

Owing to the non-availability of agricultural lands, the need for utilizing barren, saline and alkali soils, popularly known as *kallar* in Punjab, assumes importance. *Kallar* soils are unsuitable for agricultural purposes and are mostly alluvial in character, containing high proportion of soluble salts and hydrogen ion concentration varying from 8.0 to 9.5. The water available in these regions contains soluble salts.

Bricks manufactured from such soils develop scum on firing and show efflorescence, and flake on weathering. The durability of the bricks is poor due to excessive crystallization of salts occurring over the brick surfaces. These bricks contribute to corrosion of reinforcement when used in a reinforced structure, and yield poor adhesion with plaster. The vitrification range of these soils is low. Also, the presence of high proportion of salts in the soil causes excessive deterioration of the kiln chimneys during the firing of bricks.

An investigation to utilize the *kallar* soils for the manufacture of bricks was taken up by the Central Building Research Institute (CBRI), Roorkee.

A few soil samples from Delhi and Haryana were examined and found to contain soluble salts, mostly as chlorides and sulphates of sodium and magnesium (0.2 to 0.5%). Well water in these areas contains high proportion of soluble salts (1.5 to 2%). The bricks produced from these soils show heavy efflorescence and scum. Detailed investigations on salt retention in fired bricks showed that the addition of a small proportion of common salt, 0.5 to 0.7% (on dry weight basis of the soil), and hard burning decrease salt retention in fired bricks; scum and efflorescence are also reduced. Bricks of strength 100-150 kg/cm², water absorption 10 to 15%, and free from efflorescence and scum can be manufactured from these soils by the addition of requisite amount of common salt and hard burning at a firing temperature of 1020 to 1060°C.

Hydrogenation of Soap Solutions

Soap hydrogenation involving catalyst poisoning is of interest as it could represent a magnified version of normal fat hydrogenation in which catalyst poisoning is slower. The nature of the reaction was studied by hydrogenating solutions of the soaps of various unsaturated fatty acids and their mixtures over nickel catalysts. The effect of the presence of soap on the course of hydrogenation of refined groundnut oil was also examined. The studies were carried out by Shri D. Satyanarayana Raju of the Regional Research Laboratory (RRL), Hyderabad under the guidance of Dr K. T. Achaya.

Potassium soaps of pure oleic, elaidic and linoleic acids and the soapstock from alkali-refined groundnut oil were diluted with water (50%), over-alkalified about 5% and hydrogenated in autoclaves at 150-180° and 20 kg/cm² hydrogen pressure over 1-2% of Rufert nickel catalyst for periods of up to 10 hr. Samples drawn at various time intervals during the hydrogenation were converted to methyl esters and analysed for the degree of saturation (iod.val.), *trans* content (by IR), conjugation (by UV) and fatty acid composition (by GLC). They were resolved into saturates, *trans* monoenes, *cis* monoenes and dienes either by preparative argentation TLC or by argentation column chromatography. Each of the monoene fractions thus isolated was oxidized with permanganate periodate to the corresponding dicarboxylic acid. The acids were in turn esterified and analysed by GLC, to yield the proportions of positional isomers originally present. In the potassium linoleate hydrogenation study, the diene fraction was rechromatographed by TLC into four constituents, each of which was oxidized separately.

The features common to both the hydrogenations, viz. of soap solutions of oil poisoned with soap and of oil not containing soap are: (i) formation from linoleate of *trans* 10- and 11-monoenes; (ii) formation of polymer products from dienes; (iii) wider distribution of isomers in the newly formed monoene species than in the original; (iv) five-fold rapid saturation of *trans* mono-

enes than of *cis* monoenes; and (v) extensive shifting towards the end of reaction of double bonds both from *cis* to *cis* and *trans* to *trans* forms, rather than cross-isomerization between these forms, with the *cis:trans* ratio for each monoene tending to 1:1.

In the hydrogenation of groundnut soapstock at high pressure, the hydrogenation of linoleate to *trans* monoene is suppressed, but not the conversion of *cis* to *trans* monoenes. Failure of linoleate to conjugate when placed in competition with *cis* monoene appears the most likely explanation.

When groundnut oil was hydrogenated at low hydrogen pressure in the presence of small quantities of soap, suppression of the dissociation of hydrogen molecules to atoms on the catalyst surface seems to explain best the observed facts of normal transformation of linoleate to *trans* monoene, but of suppression of the conversion of *cis* monoenes to *trans* forms.

Shri Satyanarayana Raju was awarded the Ph.D. degree of the Banaras Hindu University (1969) for his thesis, 'The nature and transformation of vegetable oils and associated products by hydrogenation'.

Biochemical Studies on Pathogenic Helminths

The metabolism of some hexoses under *in vitro* conditions by *Litomosoides carinii* (cotton rat filarial worm), *Chandlerella hawkingi* (crow filarial worm) and *Ascaridia galli* (fowl intestinal nematode) was investigated as part of a programme of work on the chemotherapy of filarial and other helminth infections in progress at the Central Drug Research Institute (CDRI), Lucknow. The filarial worms used up glucose or mannose readily but galactose and fructose poorly. Enzymic studies on cell-free extracts revealed the presence of almost all the key enzymes involved in the operation of Embden-Meyerhof glycolytic pathway.

The chemical composition of *C. hawkingi* and different anatomical parts of *A. galli* was also studied and some significant differences were

observed. Purification and characterization of aldolase, enolase and glucose-6-phosphate dehydrogenase of *A. galli* were carried out to find out the effect of drugs on the purified enzymes.

The effect of some metabolic inhibitors and antifilarial compounds on sugar utilization and lactic acid production by the filarial parasites as well as enzymes of the host and the parasites was studied. Among these agents, cyanine-863 inhibited both the consumption of glucose and formation of lactic acid as well as aldolase activity in both the filarial worms. Cyanine-863 was also found to inhibit partially purified *A. galli* rat liver or crystalline rabbit muscle aldolase.

The inhibition of glucose consumption by filarial worms in the presence of cyanine-863 was concluded possibly due to the blockade at aldolase step.

The studies indicate that a medium fortified with glucose or mannose would meet the energy requirement of *C. hawkingi* for its survival. This finding may be useful in exploring the mechanism of action of anthelmintic agents. The differential action of some metabolic inhibitors on the key enzymes of glycolysis could also be exploited for more detailed chemotherapeutic studies.

Shri V. M. L. Srivastava of the institute, who carried out the studies under the guidance of Dr C. R. Krishna Murti, was awarded the Ph.D. degree of the Agra University (1970) on the basis of the thesis relating to the work.

FAO Training Centre at CLRI

An FAO training centre on hides, skins and leather was organized at the Central Leather Research Institute (CLRI), Madras from 31 Jan. to 15 Feb. 1970. The centre provided a forum to review and analyse the problems relating to the growth of the leather industry in the developing countries in the face of competition. Representatives from Ethiopia, Iran, Lebanon, Nigeria, Philippines, Rwanda, Somalia, Turkey, Zambia and the host country participated in the FAO Centre and also attended the Tanners Get-together (1970) and the International Leather Fair (1970) held concurrently at the CLRI campus.

Two important recommendations made at the sessions were in regard to the drawing up of a balance-sheet of the status of the tanning industry in the developing countries with respect to resources, consumption, imports and exports; and improvement both of the raw materials for the industry and of the existing pre-tanning techniques. Provision of incentives and capital for industrial entrepreneurs by governments was advocated for the manufacture of finished leathers, footwear, etc. Finances could be arranged through World Bank or other banks or bilateral agreements or through FAO Industry Programmes.

The centre helped to achieve closer cooperation between CLRI and the FAO projects in developing countries. It also provided an opportunity to the delegates of FAO to get to know the institute's work in the context of growth of industry concerning hides, skins and leathers in developing countries. The delegates suggested that such training centres may be arranged once in two years at CLRI for follow-up action and review of the progress made. In view of the recommendation made by the training centre, the Government of India and the FAO of the United Nations may consider utilizing the expertise and services of CLRI for planning and development of leather industries in the developing countries.

Tanners Get-together at CLRI

A Tanners Get-together, sponsored jointly by the Small Industries Service Institute, Leather Export Promotion Council (Madras), Export Promotion Council for Finished Leathers and Leather Manufactures (Kanpur), Indian Leather Fair Society (Madras), Indian Hides and Skins Improvement Society (Madras) and CLRI was held in Madras from 31 Jan. to 6 Feb. 1970. An annual feature of CLRI activities, the present get-together covered in five sessions the technological and industrial aspects of crust leathers and leather products for export.

Recommendations made at the get-together related to: (1) price control of raw hides and skins, and resultant prices of EI leathers through a planned and effective programme of collection of raw materials and their distribution to

tanners by a marketing organization; (2) free import of leather auxiliaries and machinery not manufactured indigenously; (3) making available acrylic binders at Rs 5/kg; (4) switchover to the production of ready-to-finish chrome crust and finished leathers for export instead of the present trend of exporting wet blue chrome; and (5) import of raw fur skins and export of dry furs in view of the fact that the fur industry is faced with higher costs of production. The get-together also recommended: that the Government of India should allow collaboration with other countries for setting up tanneries for leather manufacture in developing countries like Africa, and that a consortium of Indian finishers be formed to establish finishing units in important buying centres abroad. It also recommended that export incentives should be offered by reducing export duty on EI and snake skins, subsidizing air freight exports and also of the items which face high tariff in importing countries and by offering financial assistance to exporters. Establishment of separate research units for footwear and leather goods, and setting up of a permanent advisory committee for the industry and licensing with the help of CLRI, were the other recommendations.

PATENTS FILED

122638: Improvements in or relating to the manufacture of cashew-nut shell gum, T. R. Ingle, S. H. Vaidya & M. U. Pai—NCL, Poona.

123640: A process for making photoconductive plates for electrophotographic machines, P. C. Mahendru, D. C. Parashar, G. D. Sootha, D. Singh & N. Kumar—NPL, New Delhi.

123838: Improvements in or relating to hard ferrites, T. V. Ramamurti, S. C. Gupta, N. R. Nair & B. S. Khurana—NPL, New Delhi.

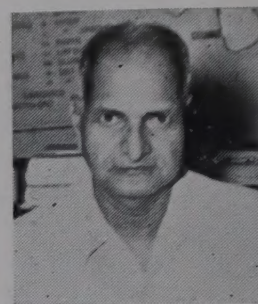
125548: An improved process for iron smelting with non-metallurgical coke, V. A. Altekar—NML, Jamshedpur.

125851: Process for the production of cellulose sulphate from cotton linters suitable as additives for oil-well cements, T. Seshadri, T. C. Saikia, S. N. Dutta, B. P. Chaliha & M. S. Iyengar—RRL, Assam.

Dr M. S. Krishnan

It is with deep regret that we record the demise of Dr Maharajapuram Sitaram Krishnan in Thanjavur (Tamil Nadu) on 24 April 1970.

Dr Krishnan (b. 24 Aug. 1898 in Maharajapuram, Tamil Nadu) received his early education at Tanjore, Trichinopoly and at the Presidency College, Madras. After obtaining B.A. (Hons) and M.A. degrees



in geology from the Madras University in 1919 and 1921 respectively, he joined the Imperial College of Science, London, and obtained Ph.D. and D.I.C. On returning he joined the Geological Survey of India in 1924 and became its first Indian Director in 1949. He was also Director, Indian Bureau of Mines from 1948 to 1951, and Joint Secretary in the Union Ministry of Natural Resources & Scientific Research from 1955 to 1957. Dr Krishnan was awarded Padma Bhushan this year for outstanding contributions to geology.

Dr Krishnan carried out extensive geological mapping and investigations on various mineral deposits in different parts of India. An international figure in geology, Dr Krishnan was the author of the textbooks, 'Introduction to the Geology of India' and 'Geology of India and Burma'. He revised (with Dr K. Jacob) the lexicon of 'Indian Geological Terminology', published by the International Geological Congress.

Dr Krishnan was associated with the Council of Scientific & Industrial Research in several capacities. He was member of the editorial committee of the *Wealth of India* encyclopedic series. He was member, Geological & Mineralogical Research Committee. He was the first Director (Oct. 1961 to Oct. 1963) of the Central Board of Geophysics, renamed National Geophysical Research Institute (NGRI), Hyderabad. He was also associated with the Regional Research Laboratory, Hyderabad and NGRI, Hyderabad as member of their executive councils.